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Tantalum Gauze in the Repair of Hernias Complicated by Tissue Deficiency:

Tantalum gauze is a finely woven mesh of monofilament tantalum wire, from 2 to 5 mils in diameter (a mil is 0.001 of an inch). The finest weave, 100 by 100, resembles heavy sheer cloth. The weave more commonly used, 50 by 50, is a light, strong, and pliable screen. It is biologically inert in the tissues, and forms a scaffold for the ingrowth of white fibrous tissue which firmly closes the hernial defect. Its use is relatively simple when compared to many autoplasmic procedures, and its adaptability is satisfactory in the various situations which arise during a difficult herniorrhaphy, in which the proportions of the defect are such that the proximation of its edges is difficult or impossible.

This study is based upon the experience derived from seventeen herniorrhaphies in which tantalum gauze was implanted for the purpose of closing and buttressing the defect present. The hernias so treated were of the type wherein the application of "standard operations" offered little assurance of a satisfactory result. Tissue deficiency, with or without congenital anatomic weakness, was the principal etiologic factor in every hernia in this series. Of these operations, two were done for postoperative ventral hernia, six were done for direct inguinal hernia, five were done for recurrent inguinal hernia, one was done for indirect hernia, two for indirect sliding hernia, and one for obturator hernia. The patients have been followed, except for one with a bilateral operation, at frequent intervals both by physical examination and roentgenography of the tantalum gauze implants.

The technic of tantalum gauze herniorrhaphy is capable of almost unlimited modification to fit the individual situation. Such a mesh, together with its ensheathing white fibrous tissue, forms an impervious patch wherever the surgeon places it. In the continued use of this material, certain features have assumed increasing significance:

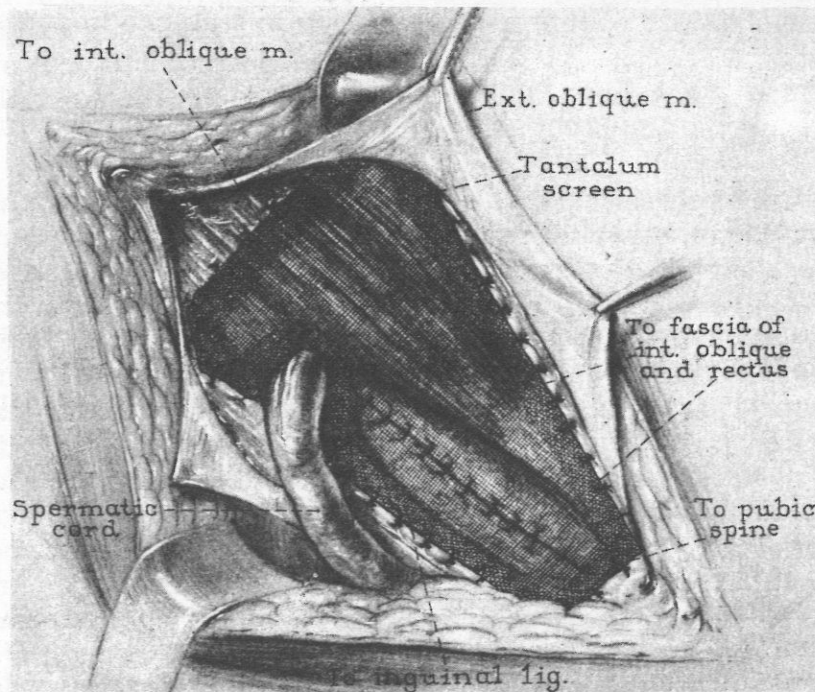
1. The cut edges of the implant should be folded under for approximately 1 cm. This serves the double purpose of creating a smooth, atraumatic edge, and also making it possible, when suturing the mesh in place, to pass all sutures through a tough, double thickness of material.
2. All sutures holding the implant in position should be placed in strong white fascia or periosteum, and the dissection must expose these structures adequately. The dimensions of the implant are limited not by the size of the actual defect to be covered, but by the position of reliable supporting structures.
3. The implant must be of such generous proportions that it can be sutured in place without tension. More herniorrhaphies have been defeated in purpose by tension than by choice of suture material.
4. The suture material used to hold the tantalum gauze in place should be monofilament tantalum wire. The 10-mil size has seemed best suited to this purpose. The braided tantalum wire, although slightly easier to tie, was discarded because its finely serrated surface produced a notable "drag" when

drawn through the screen. Other types of wire sutures were not used because of a difference in electrolytic potential between them and the gauze implant.

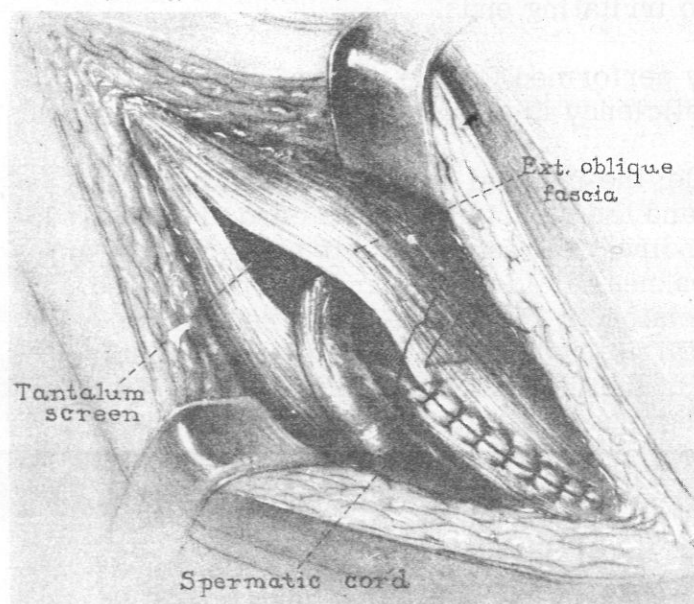
5. The wire sutures should be cut "on the knot." If unaccustomed to the use of metallic sutures, the surgeon may experience some initial difficulty with tantalum wire. A continuous type of suture should not be used. One-handed knots are not satisfactory. A simple square knot should be tied, with only sufficient tension on the first throw to coapt the structures being sutured. The second throw must lie flat and should be set snugly. The ends of the suture are then crossed to form a V, with the apex just above the knot. The suture is then cut at this apex, leaving no irritating ends.

The tantalum gauze herniorrhaphy performed for the cure of direct inguinal hernia associated with tissue deficiency is as follows:

The usual inguinal incision is made; the inguinal canal is opened by incising the fascia of the external oblique, and the structures of the cord are isolated. These are carefully examined for an indirect sac, and retracted with a strip of Penrose rubber tubing. The direct weakness is identified and the sac treated as the situation requires, either by excision or inversion. If the rent in the transversalis fascia can be repaired, this is done. No effort is made to suture a friable, attenuated, conjoined tendon to the inguinal ligament. Instead, the defect is covered with a patch of tantalum gauze. This is cut to size at the operating table, the edges doubled under, and it is sutured in place as shown below. All suture material in this repair, except purse strings and ligatures,



is 10-mil tantalum wire. The usual tantalum implant is sutured medially to the periosteum of the pubic bone, the edge of the rectus sheath, and the sturdy white fascia of the internal oblique muscle. Laterally, the sutures are usually placed in the shelving edge of the inguinal ligament. On occasion, when this latter structure has been deficient, the inferior-lateral sutures have been placed in Cooper's ligament after the fashion of the McVay herniorrhaphy. The structures of the cord are brought out through a small somewhat triangular opening made high on the lateral border of the implant. The cord is then placed in the subcutaneous position by closing the fascia of the external oblique beneath it and over the implant as shown in the figure below. The



superficial fascia and skin are closed as usual. This method is equally applicable, when indicated, to indirect hernias with a large defect in the floor of the canal (as in certain sliding hernias), and to recurrent inguinal hernias. In the latter, because the hernia is usually direct and the inguinal region presents such a chaos, it occasionally has been necessary to use Cooper's ligament in lieu of the deficient or absent inguinal ligament. On several occasions, the lateral margin of the implant has extended from the pubic spine to the

anterior-superior spine of the ilium, thus reinforcing the entire inguinal ligament.

The moderate-sized ventral hernia, with good adjacent tissues, is satisfactorily repaired by one of several operative technics. The large ventral defect, in an obese patient whose flabby abdominal musculature is a covering rather than a support, presents a situation that demands a radical effort if a cure is to be anticipated. The use of a tantalum gauze patch over such an abdominal defect is logical and offers a simple operative procedure in lieu of a difficult one. The operation is carried out as usual to the stage of the actual repair. The peritoneum is closed and the attenuated tissues about the defect are excised back to normal structures. If it is possible to approximate the wound edges by imbrication and without tension, this is usually satisfactory and the use of tantalum mesh is not indicated. However, if imbrication cannot be accomplished without tension, the fascia is simply approximated over the peritoneum with interrupted sutures of tantalum wire, and a rectangular tantalum gauze implant is sutured over the repair. All sutures are taken in the fascia and without tension. In case the fascia cannot be approximated over the whole of the defect, the edges can be drawn into proximity with wire sutures and the tantalum mesh

implanted directly over the peritoneum as it bulges into the hiatus. The subcutaneous tissues and skin are closed over the implant.

No patients have been seen with femoral hernias of such magnitude or tissue deficiency as to require a tantalum mesh implant. The inguinal approach to femoral herniorrhaphy usually is most satisfactory. If the inguinal ligament were deficient, it would be a simple matter to utilize Cooper's ligament in a tantalum gauze herniorrhaphy, as is sometimes done in certain inguinal hernias. Such an implant would completely block the internal femoral ring and should prove as satisfactory in the treatment of difficult femoral hernia as it has in the repair of inguinal hernias with associated tissue deficiency.

One patient with obturator hernia has been treated with a tantalum gauze implant. This is the subject of a separate report. The procedure was carried out as an intraperitoneal operation. A small rectangular tantalum mesh implant was fastened over the defect with a single suture in each corner, utilizing the periosteum in the superior sutures and the obturator membrane in the inferior ones. The obturator vessels and nerve ran beneath the lateral edge of the implant without compression.

Metal fatigue or "work-hardening" is a property of all metals and must be considered in their application to surgery. Repeated bending of a wire ultimately leads to fracture at the site of angulation. Tantalum is not immune to work-hardening, although it is more resistant to fatigue than many other metals commonly used for tissue implantation. Tantalum wire resists work-hardening and fracture approximately twice as well as stainless steel alloy wires of comparable sizes. It is apparent from bending tests that the larger and more rigid the wire, the more it is subject to metal fatigue. Although there have been no hernial recurrences as yet following the tantalum gauze herniorrhaphies in this series, there is x-ray evidence that some of the implanted mesh has fractured. This has become apparent after about twelve months in some patients. The 100 by 100 mesh gauze and the gauze woven of 5-mil wire is more prone to fatigue and fracture than the 50 by 50 mesh gauze woven of 3-mil wire. This was the source of considerable apprehension to the author until he persuaded one of the patients to allow the exploration of a previously performed tantalum gauze herniorrhaphy at the time of operation for hernia on the other side. A small secondary incision through the old scar revealed a firm inguinal region. It was impossible to dissect the fascia of the external oblique from the underlying tantalum gauze implant, so firmly were the two united in dense white fibrous tissue. When the upper margin of the implant was freed, a finger could be slipped beneath the entire piece of tantalum mesh with ease. Although the implant was completely ensheathed in dense collagenous tissue, there were no adhesions to the underlying structures. It appeared as if a supplementary sturdy fibrous tissue sheet had been added to this region without the incorporation of underlying contiguous structures. A small corner of this implant was removed for study. The wire gauze was found embedded in dense fibrous tissue, extending approximately from 3 mm. to 4 mm. on either side of the mesh. The individual wires of the gauze were clothed by this fibrous sheath much as the

steel rods in reinforced concrete. It appeared impossible for the implant, or any fragment thereof, to become fugitive in the tissues. Furthermore, the factor of work-hardening would seem to assume more academic than practical importance.

The ultimate strength of the tantalum gauze herniorrhaphy is dependent upon the production of a fibrous tissue patch, secondarily reinforced by the ensheathed mesh implant. However, it seems reasonable that the formation of this sheath must require several months. The question then arises concerning the strength of this implant during the period of healing. Pull tests, using a Tinius Olsen testing machine, were done on 1/2 inch strips of 50 by 50 mesh 3-mil wire tantalum gauze. Using a 3/8 inch pull speed per minute, the average stress at the breaking point was 17.5 pounds. A wire mesh of this type, even initially, would seem to have more strength on lateral pull than the tissues to which it is anchored.

In this small series of cases, there were three wound complications. One patient, on whom a tantalum gauze herniorrhaphy had been done for direct inguinal hernia, developed a simple accumulation of serous fluid in the subcutaneous tissues. This was aspirated, a pressure dressing applied, and healing progressed without further measures. Another patient had a large recurrent ventral hernia. The overlying skin was ulcerated and two sinus tracts were present from the previous operation. Tantalum mesh was implanted in the process of the repair, and penicillin used postoperatively. There was a slight amount of serous drainage from one angle of the incision for two weeks. The third instance of wound complication followed the repair of an enormous scrotal sliding hernia. A motion picture was taken of this procedure, during which skin towels and draperies were changed several times. The patient subsequently became febrile and several ounces of pus were evacuated from the incision. Healing progressed satisfactorily and all drainage had ceased in four weeks. From these experiences it would seem that the tantalum implant has no deleterious influence on the course of minor wound complications. The remainder of the wounds healed by first intention, without induration and with less discomfort than is usually experienced in catgut or fascial transplant herniorrhaphies.

No patient in whom tantalum gauze was implanted had subjective complaint referable to the implant. In one patient, an extremely slim, elderly man, a corner of the mesh was palpable subcutaneously, but without discomfort. Another patient was operated upon for bilateral recurrent inguinal hernias. Tissue deficiency was so marked on one side that a tantalum gauze implant was used. He knew the implant was used, but remained unable to tell in which side it was inserted. These patients were subjectively unaware of the tantalum gauze, and several of them later did hard physical work.

There were no testicular complications in this small series of inguinal herniorrhaphies with tantalum gauze. In the fourteen men operated upon, orchiectomy was done once to effect the complete closure of a huge sliding hernia. In the remaining thirteen cases, the spermatic cord was led from the abdomen

through a small triangular defect in the lateral or superior border of the implant and placed in the subcutaneous position. A pressure scrotal dressing was applied at the time of operation, and these dressings were replaced by a conventional scrotal support on the fourth or fifth postoperative day. There were no instances of testicular swelling or subsequent atrophy.

Each patient operated upon in this series was a likely candidate for a hernial recurrence. That there have been no recurrences to date is gratifying, but does not imply the infallibility of this procedure. The routine use of tantalum gauze in herniorrhaphy is not advocated, but further trial of this material as an adjunct in the repair of hernias in which tissue deficiency plays a dominant role would seem justified. (Surgery, Jan. '48 - T. D. Throckmorton)

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Physiology of Respiration as Applied in the Treatment of Bulbar Poliomyelitis: The high mortality in bulbar poliomyelitis makes patients with the disease a critical problem for the physician. The involvement of the nervous centers for control of respiration and circulation as well as those centers controlling the skeletal muscles presents a complicated problem in clinical physiology. Many lives can be saved by the early correction of the respiratory deficiencies encountered in this disease, whereas even slight delays in the institution of proper therapy may render the most heroic efforts futile.

The successful application of the fundamentals of respiration to the treatment of poliomyelitis requires the appreciation and solution of at least three basic problems encountered in the course of the disease.

- I. Inadequate pulmonary ventilation, due to
 - A. Intercostal and diaphragmatic paralysis brought about by cervical and thoracic cord involvement
 - B. Respiratory center paralysis with normal cervical and thoracic cord function
 - C. Obstruction of the upper airway due to laryngeal and pharyngeal paralysis and inability to clear secretions
- II. Lung pathology
 - A. Reduction of gaseous exchange between blood and alveolar contents due to pulmonary edema and capillary hemorrhage
 - B. Atelectasis
- III. Barriers to diffusion of gases between capillaries and nerve cells

During the acute phase of the disease, attention should be directed toward maintenance of normal function of the involved nerve cells, and every effort should be made to prevent further embarrassment of the diseased cells in order to minimize destruction of vital nerve tissue.

Hypoxia quickly destroys neurons. It is possible that the cells already attacked by the poliomyelitis virus are even more susceptible to hypoxia. Therefore, the aim of oxygen therapy should be to maintain an uninterrupted normal arterial oxygen tension of at least 100 mm. of mercury. An oxygen tension less than 100 mm. may impair the function of the vital centers.

It is important to call attention to some of the frequently disregarded physicochemical aspects of oxygen transport in the presence of the conditions mentioned. The usual laboratory test in regard to oxygenation is the determination of the percentage of oxygen saturation of the hemoglobin in the arterial blood. This is a most useful adjunct, but it may also lead to erroneous conclusions concerning the amount of oxygen reaching the cells. It has been shown that small decreases in percentage of oxygen saturation of hemoglobin represent large changes in partial pressure of oxygen in solution in the plasma. In the final analysis, the difference in partial pressure of oxygen between plasma and the fluid surrounding the oxygen-consuming cell is one of the factors which determines the rate at which oxygen flows from plasma to cell. For example, if the percentage of saturation of hemoglobin is reduced from the normal of 96 percent to 90 percent, the partial pressure of dissolved oxygen in the plasma falls from 100 to 60 mm. of mercury; this means a reduction of at least 40 percent in the force which moves oxygen from plasma to cell. Clinically, cyanosis has too frequently been regarded as the first sign of oxygen deficiency and as an indication that remedial therapy should only then be initiated. Unfortunately, cyanosis is seldom detectable if the saturation of hemoglobin is above 80 percent. At a saturation of hemoglobin of 80 percent, the partial pressure of oxygen has been reduced to only 45 mm. of mercury. In other words, when cyanosis is first visible, the flow of oxygen from capillary blood plasma to nerve cell may be decreased by at least 65 percent. This makes it obvious why the patients with bulbar poliomyelitis who become cyanotic most often succumb.

Another important consideration in the oxygen transport system is the condition of the immediate environment of the nerve cell receiving oxygen. Often in poliomyelitis, edema, perivascular infiltration, hemorrhage and debris increase the resistance to diffusion of oxygen from plasma to cell by the increased distance from capillary to cell, the physical obstruction by particulate matter, and by the increased oxygen consumption by the infiltrating white cells.

At certain times an oxygen tension of more than the normal 100 mm. of mercury may be of great benefit in overcoming the resistance to movement of oxygen from plasma to cell. If the 570 mm. arterial nitrogen tension is substituted by oxygen, the total oxygen tension becomes approximately 670 mm. Hg. This great increase in oxygen partial pressure increases the oxygen carrying capacity of the blood by only from 10 to 15 percent; however, the oxygen pressure gradient from capillary to cell is increased by approximately 600 percent. Although this pressure rapidly diminishes as the blood passes along the capillary, the oxygen-consuming cell receives a substantial increase in its oxygen supply, which in many cases constitutes the difference between life and death for the cell.

For bulbar poliomyelitis, during the 1946 Minnesota poliomyelitis epidemic, the routine treatment developed at the University of Minnesota Hospitals consisted in prophylactic tracheotomy followed immediately by oxygen therapy. Prophylactic tracheotomy was performed to insure as far as possible against any episodes of hypoxia due to obstruction of the upper airway. It was noted that the initial symptoms of hypoxia produced by partial closure of the upper airway were often extremely subtle and that if the patient experienced an interval of cyanosis the prognosis was poor.

Oxygen and helium or oxygen and air mixtures were administered via the tracheotomy tube with equipment developed at the University of Minnesota Hospitals. The gas mixtures were warmed and humidified before entering the trachea. Provision was made for positive pressure breathing. Additional oxygen was frequently administered by mask, in order to prevent dilution of the oxygen mixtures entering the tracheotomy tube by air inhaled through the upper air passage.

Because there is experimental evidence that long-continued inhalation of 100-percent oxygen may produce pulmonary damage, it is recommended that 50-percent oxygen and 50-percent helium or nitrogen mixtures be used, except when hypoxia persists in spite of the elevated oxygen intake. The rationale of helium administration has been presented by several investigators.

There is little or nothing to be gained by placing a patient with bulbar poliomyelitis with only airway obstruction in the respirator, since the difficulty is not eliminated and the respiratory, laryngeal, and cardiac difficulties may only be increased. The force of the respirator may move secretions farther down the tracheobronchial tree, thus increasing the possibility of atelectasis and pneumonia. Artificial respiration is indicated only in cases of ventilatory deficiency due to partial or complete paralysis of the diaphragm or intercostal muscles or to involvement of the respiratory center. If these conditions are combined with airway obstruction, tracheotomy should be performed immediately and the patient then placed in the respirator.

The symptoms of hypoxia are often subtle and easily mistaken for other neurologic disorders. Some of the commoner effects of hypoxia are headache, irrational states, hyperpyrexia and tachycardia. Cullen and Skewis stated that the most reliable sign of early oxygen want is an increased pulse rate. They reported that if oxygen is discontinued, and the pulse rate increases, the patient still requires excess oxygen. Likewise, hyperpyrexia may be due to depression of the temperature-regulating center by hypoxia and be relieved by adequate oxygenation. The following case demonstrates tachycardia and hyperpyrexia on the basis of hypoxia:

A 17-year old boy had severe bulbar involvement upon admission to the University Hospitals. Because of laryngeal and pharyngeal paresis, tracheotomy was performed to provide an adequate airway. Immediately after the tracheotomy, large quantities of viscous fluid welled up through the tracheotomy

tube. After approximately three hours' inhalation of 50-percent oxygen and 50-percent helium, the trachea became clear of fluid. Twelve hours after tracheotomy, the temperature had decreased from 104 to approximately 100.5 F., and the pulse rate dropped from an average of from 120 to 100 per minute. The temperature and pulse remained at this level for six days and then gradually fell to normal. The patient was comatose for ten days and received only intravenous feeding for thirteen days. The rate of intravenous infusion was restricted to a maximum of 200 c.c. per hour to prevent lung edema by flooding of the cardiovascular system. On the fourteenth day, the patient began taking liquid food by mouth, and thirty days later he was discharged from the hospital with only a residual paresis of the soft palate and unilateral vocal cord paralysis.

This case, like several others, illustrates that tachycardia and hyperpyrexia are often the symptoms of hypoxia and can be relieved by proper oxygen therapy if applied before permanent damage has occurred. The ordinarily commendable technic of long and careful observation of symptoms and findings before the start of therapy will only lead to continuation of the high mortality rate in bulbar poliomyelitis. This type of patient presents a rapidly changing set of conditions in the acute phase of the disease. The fact that infection may spread only a few millimeters and thereby depress or completely abolish the function of a vital center makes the acute phase of the disease a dynamic and treacherous process. Superimposed upon the rapid and destructive effects of the poliomyelitis virus are the lethal effects of hypoxia, which occur in even shorter time than those of the virus. Perhaps the most difficult aspect of the problem confronting the physician responsible for the care of patients with bulbar poliomyelitis is the detection of hypoxia. Repeated observations indicate that if cyanosis is used as a criterion for initiating treatment for hypoxia, the patient has little chance of survival because of the extensive damage to the nervous system produced by the greatly reduced flow of oxygen to the diseased nerve cells. Since the early symptoms of hypoxia are neither so dramatic nor so obvious as cyanosis, the physician must rely on the more sensitive indicators, such as the pulse rate, temperature, and irrational states. Dripps and Comroe reported that decreasing the oxygen content of the inspired gas mixtures by only 2 percent (from 20 to 18 percent) produced a significant elevation of pulse rate in 70 percent of the normal men tested, whereas a slightly greater decrease in oxygen intake produced an increase in respiratory minute volume. It is important to determine whether or not hypoxia is the cause of any variations in temperature, pulse, and respiration occurring in the course of bulbar poliomyelitis. (Arch. Phys. Med., Feb. '48 - W. G. Kubicek et al.)

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Postoperative Use of Modified Test for Blood Coagulability: In 1944, Waugh and Ruddick reported a new test for increased coagulability of the blood, based on controlled deceleration of the clotting mechanism through the use of heparin. Although it was appreciated that temperature affected the test, the original work was done at a time when room temperature was constant (i.e., during the winter months), so that special precautions in this direction were

unnecessary. Later, Whittaker, working during the summer months, when room temperature fluctuations were present, experienced some difficulty in obtaining duplicate curves, and worked out in detail the facts concerning the effect of temperature on the test. She found that between 20 and 35 degrees Centigrade, increase in temperature caused a decrease in clotting time. This stressed the fact that comparison of the blood coagulation curves in different individuals, or in the same individual at different times, is possible only if the tests are conducted at the same temperature.

Application of the test clinically revealed an increased coagulability of the blood under a wide variety of circumstances. These include pneumonia, empyema, peritonitis, and other acute infectious processes, and also following hemorrhage, and after surgical operation, etc. More recently, Ogura and colleagues have used the Waugh-Ruddick test to study changes in blood coagulation following coronary thrombosis. They found that in 27 patients, 77.8 percent showed a decreased coagulation time. This was usually evident by the second or third day following the thrombotic incident, and lasted to about the seventeenth day. Acceleration was prolonged beyond the third week in a few cases, but in every instance, the clotting mechanism was indistinguishable from normal after the fourth week.

The present report deals with (1) a proposed modification of the test, and (2) the application of the modified test to the study of postoperative blood coagulability.

Using the original method of Waugh and Ruddick, blood coagulation studies were carried out on 43 student volunteers. In comparing the results obtained for this group with those obtained by the original investigators, it was seen that the actual values differed greatly in the two series. There appeared to be two chief reasons for this: (1) the heparin employed was of different batches and thus possibly of somewhat different potencies, and (2) the end point in each tube was not sharply defined, and consequently there arose the question of interpretation of results. These and other reasons for modifying the test can be summarized as follows:

1. To shorten the time needed to complete a test.
2. To perform the test under controlled temperature conditions.
3. To obtain a sharper and more definite end point in all tubes.
4. To reduce the amount of blood needed to perform the test.

The modification is in reality a combination of Quick's method of determining the clotting time of recalcified plasma and the Waugh-Ruddick test. Using this modification (the details of which are set forth in the original), tests were performed on 9 patients admitted to the Royal Victoria Hospital for operation. A special effort was made to use patients with no acute illness or any other condition likely to affect the coagulability of the blood. Eight of these were for appendectomy or herniorrhaphy. The ninth was for a gastrectomy. All operations were performed under spinal anesthesia. Coagulation tests

were done preoperatively and as often postoperatively as possible, commencing the day after operation.

The results indicated that there is a definite increased coagulability of the blood postoperatively. This begins within 24 hours after operation, and may last, in varying degrees, for a week or more. There does not appear to be a definite order in which the coagulability changes from day to day, but this is hardly to be expected, because the test must of necessity be a qualitative rather than a precisely quantitative affair. In all cases in which hospitalization was long enough to permit observations, the coagulation time was normal at the end of two weeks.

Quick points out that "thromboplastin is the trigger-substance in the coagulation process. It initiates and determines the speed of the reaction." If this is so, then the decreased coagulation time seen postoperatively can be explained by an increase in the amount of available thromboplastin. There are two reservoirs of this material, namely the platelets and the tissue juices. In 1926, Hueck first demonstrated the presence of a postoperative thrombocytosis. This has since been confirmed by many other workers. All agree that this increase in platelets occurs about the sixth or seventh postoperative day. It therefore cannot explain the increased coagulability of the blood seen within 24 hours after operation.

On the other hand, an increase in the circulating thromboplastin, presumably derived from damaged tissue in the operative area, is a much more likely explanation. This view has been favored by Pickering and Mathur, Dougal and others, and is supported by observations that the blood urea and polypeptides are increased postoperatively. Snell and Bancroft point out that after operations on obese patients there may be an increased liberation of thromboplastic lipid substances such as cephalin, due to extensive areas of fat invaded. Waugh and Ruddick showed that the addition of thromboplastin to plasma caused a clockwise shift of the coagulability curves, such as has been shown to occur postoperatively. It would appear that the mechanism is the same in both instances. (Blood, J. Hematol., Feb. '48 - S. B. Silverman)

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Toxic Effects of Benadryl (Beta-Dimethylaminoethyl Benzhydryl Ether Hydrochloride) in Aviation Personnel: Preliminary studies conducted by investigators at NMRI on a project, "To Evaluate and Study Certain Agents and Drugs that Effect the Performance of Aviation Personnel," indicate that the toxic effects of Benadryl are such that the piloting of aircraft during the course of the drug's action may be hazardous.

The promiscuous use of Benadryl by personnel as a means of "aborting the common cold," and the ease with which that drug may be procured emphasize the need for an appreciation of this knowledge by medical officers (particularly those in aviation medicine).

The onset and duration of action of Benadryl is dependent upon the amount ingested and the susceptibility of the individual. The following toxic symptoms in the order of their frequency have been cited in the literature; drowsiness, dizziness, weakness, dimming of vision, difficulty in coordination, loss of visual acuity, nervousness, ("jitters"), loss of alertness, mental confusion, nausea, ataxia, and stupor.

In this preliminary study, Benadryl was administered to human subjects who were tested in the Link Trainer 30 minutes after each dose. The dosage was that commonly used in aborting the common cold, namely, 50 mg. taken every 4 hours for a total of 150 mg. in 3 doses. A base line of human performance for simple problems with the Link was established. The results of the study were correlated with the human production and performance curve of the hour of the day.

In these subjects the following effects in relation to the dose and the time of ingestion were noted:

<u>Time</u>	<u>Dose</u>	<u>Effects</u>
0800	1st - 50 mg.	
0830		Dryness of nose and throat (objective and subjective) Slight drowsiness (subjective)
1200	2nd - 50 mg. (100 mg. total ingested)	
1230		Nervousness (subjective) Difficulty in concentration (subjective)
1600	3rd - 50 mg. (150 mg. total ingested)	
1630		Sleepiness (subjective) Weakness (subjective) Loss of mental alertness (objective and subjective) Mental confusion (objective) Difficulty in coordination (objective)

The effects of this drug in these dosages completely disappeared after 12 hours, 8 of which were occupied by sleep.

From the foregoing it may readily be appreciated that the correct performance of duties, such as are involved in the operation of aircraft, is hazarded while the pilot is under the effects of this drug. (E. E. Metcalfe)

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Experiments on the Role of the Chicken Mite, *Dermanyssus Gallinae*, and the Mosquito in the Epidemiology of St. Louis Encephalitis: In previous reports from the laboratory of the Department of Pathology and the Department of Pediatrics, Washington University School of Medicine, St. Louis, evidence was presented that the chicken mite (*Dermanyssus gallinae*) is capable of transferring the virus of St. Louis encephalitis congenitally to its offspring ad infinitum, and that a colony of mites once infected probably remains infected indefinitely. Uninfected mites derived from a single female and her nymph offspring and shown to be free of virus could be infected readily by feeding on animals inoculated with various strains of the virus of St. Louis encephalitis. Experimentally infected mites as well as those found infected in nature proved capable of transferring the virus through the egg to their offspring. Both naturally infected and experimentally infected mites transferred the virus to chickens by bite. Uninfected mites could acquire virus from chickens bitten by infected mites. Viremia in chickens bitten by such mites was demonstrated with regularity by the use of the chorioallantoic passage and subsequent intracerebral inoculation of mice. Isolation of the St. Louis encephalitis virus from mites in nature and results of laboratory experiments indicating maintenance of the virus in mites suggest that the mite may serve as a reservoir in nature. Likewise the fact that virus is present in the blood of chickens following the bite of infected mites suggests the possibility that during the period of viremia such chickens might serve as a source of virus for other blood-sucking vectors, possibly the mosquito, of which several species are known to feed upon chickens.

The primary purpose of the present investigation was to ascertain (1) whether or not mosquitoes can acquire the virus of St. Louis encephalitis by feeding on chickens infected by mites, and (2) whether or not mosquitoes thus infected can transmit the virus to chickens, mice, and hamsters.

Seven species of mosquitoes, belonging to 3 genera, used in the present investigations, were obtained from various sources: *Culex pipiens* Linn., collected as eggs, larvae, and pupae in St. Louis County and maintained as a breeding colony at Washington University; *Culex quinquefasciatus* Say, collected as eggs, larvae, and pupae in New Orleans and maintained as a breeding colony at Washington University. *Anopheles punctipennis* (Say), collected as larvae in St. Louis and vicinity; *Anopheles quadrimaculatus* Say, from eggs obtained from a colony at Tulane University (an Alabama strain) and also from eggs of females captured and from larvae collected in St. Louis and vicinity; *Aedes aegypti* (Linn.), from eggs obtained from a colony at Tulane University (a New Orleans strain) and maintained as a breeding colony at Washington University; *Aedes triseriatus* (Say), collected as larvae in the vicinity of St. Louis; and *Aedes vexans* (Meig.), collected as larvae and pupae and also from eggs laid by females captured in St. Louis and vicinity. All mosquitoes used in the experiments were reared in the laboratory from preadult stages.

During the course of the investigation, the mosquitoes were infected with the virus in one or two or all of three ways: by being fed on a suspension of infected mouse brain tissue, by being fed on chickens in which viremia had been produced by subcutaneous inoculation of virus, and by being fed on chickens having viremia

as a result of the bite of infected mites. These mosquitoes transmitted the virus to chickens at periods varying from 5 to 33 days after the infective meal.

In attempts to transmit the virus to young Swiss mice, difficulties were encountered in that the young mice were not always able to withstand the procedure and that mosquitoes did not bite mice readily. None of the mice bitten developed encephalitis.

The virus of St. Louis encephalitis was transmitted to hamsters by Culex pipiens at periods varying from 4 to 27 days after feeding on chickens having viremia as a result of the bite of infected mites. Although viremia was demonstrated readily in hamsters, signs of encephalitis did not develop.

In all transmission experiments the method of chorioallantoic passage proved necessary for the demonstration of viremia.

Within recent years evidence has been accumulating from field and laboratory studies which indicates that St. Louis encephalitis is an arthropod-borne disease. Isolation of the virus of St. Louis encephalitis from culicine mosquitoes collected in nature during epidemics and the transmission of the virus to experimental animals by the bite of mosquitoes emphasize the importance of this blood-sucking vector in the epidemiology of St. Louis encephalitis. The mosquito probably transmits the infection to higher animals and man. However, certain facts suggest that it is not the sole vector involved in the epidemiology of the disease. The virus has not been shown to persist in hibernating mosquitoes, nor has transfer of the virus in mosquitoes by way of the egg been demonstrated. Although humoral antibodies to the virus of St. Louis encephalitis are present under natural conditions in vertebrates, particularly birds, there is no evidence that these animals constitute more than a transient source of virus. Apparently, virus remains in their blood for a few days only. Thus the question where the virus of this seasonal disease persists from year to year cannot be answered on the basis of the mosquito hypothesis alone. Also, there has been no adequate explanation of why epidemics occur rarely in certain localities although a few endemic cases occur there from year to year.

The isolation of the virus of St. Louis encephalitis from chicken mites (Dermanyssus gallinae) collected under natural conditions during nonepidemic years has pointed to the possibility that this arachnid vector might be a reservoir of the St. Louis virus. It has been shown that under laboratory conditions the virus is transferred through all stages of metamorphosis in the chicken mite, and that, once infected, a colony of chicken mites, by reason of transovarial passage, may remain infected for an indefinite period. By actual test it was shown that the virus remained in mites housed in the laboratory for a period of 3 years. Although these findings suggest that Dermanyssus gallinae is serving as a natural reservoir, the possibility must be considered that this arachnid may be merely an accidental host, and hence of no epidemiologic significance. In order to determine whether the chicken mite is concerned in the natural transmission of St. Louis encephalitis, it is essential to know whether

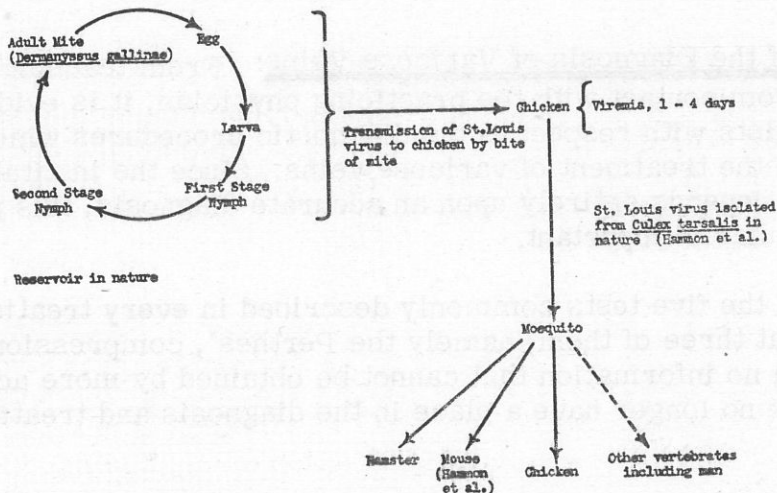
infected chicken mites feeding upon normal chickens can produce viremia. During the course of the present work this was accomplished many times, the blood of chickens fed upon by infected chicken mites being positive for virus for periods of from 1 to 3 days, and in some instances 4 days, after the feeding period. It was demonstrated that mosquitoes feeding upon chickens infected by mites can acquire virus from the blood during the period of viremia, and that mosquitoes thus infected can transmit the virus to other chickens and to hamsters. Thus it is possible that in the epidemiology of St. Louis encephalitis two blood-sucking vectors may be involved - one an arachnid, the mite, maintaining the virus by transovarial passage and the other, an insect, the mosquito, which carries the infection from birds to other vertebrates including man.

In these studies demonstration of viremia in animals fed upon by infected vectors presented technical difficulties since virus is present in small amounts in the blood of such animals. Passage on the chorioallantoic membrane was necessary in order to increase the virus to a level sufficient to produce signs of encephalitis in white Swiss mice. The question of multiplication of the virus in the body of the blood-sucking vectors was considered. In the case of the chicken mite, the demonstration of congenital transfer of the virus and the comparative ease with which virus could be isolated from mites of succeeding generations constitute indirect evidence that multiplication of the virus occurs. However, the present results give no convincing evidence that the virus multiplies in the body of the mosquitoes which were used in this investigation. On the other hand the amount of virus present in the body of the mosquitoes appeared to have a direct relation to the amount of virus ingested, even when a 2-week period of incubation was allowed; that is, virus was demonstrated readily by direct inoculation of mice, with extracts from mosquitoes which had fed on a suspension of brain tissue containing high concentration of virus; whereas extracts from mosquitoes which had fed on chickens infected by mites contained small amounts of virus, which could be demonstrated only by means of chorioallantoic passage.

Whether the virus undergoes changes in its characteristics, perhaps becoming less infective for vertebrates while maintaining itself in the body of an arthropod vector is a question. The results reported here give no evidence of such a change in the mite since the virus from the bodies of chicken mites procured under natural conditions was infective for white mice without requiring passage for adaptation, and since uninfected chicken mites were infected successfully with laboratory adapted strains: the Hubbard egg membrane strain and a strain isolated from the blood of a patient. However, no detailed studies concerning this problem were undertaken.

Although it was somewhat disappointing that the bite of infected mosquitoes which had acquired the virus from chickens infected by mites did not result in objective signs of encephalitis in hamsters or mice, viremia was demonstrated in hamsters in a significant number of instances. Even when efforts were made to break down the blood-brain barrier by the injection of aleuronat, no signs of encephalitis were observed in these animals.

These observations suggest that the epidemiology of St. Louis encephalitis is a complex one, involving two blood-sucking vectors. A representation of this concept is given in the diagram below. The chicken mite seems to be an



The possible epidemiology of St. Louis encephalitis. ----- not yet proved;
 ————— proved experimentally.

important reservoir vector in the St. Louis area. In other localities some other vector, probably an arachnid, may be playing a similar role; some species of mite, or a hard bodied tick, or a soft bodied tick are likely possibilities. Previous experiments of Blattner and Heys with the tick, Dermacentor variabilis, demonstrating that the virus of St. Louis encephalitis can be passed through the egg and into the next generation through the various stages of metamorphosis, suggested the potentiality of this arachnid as a reservoir for virus. However, in so far as the authors are aware, the St. Louis virus has not been encountered under natural conditions in any arachnid other than the chicken mite. The concept of epidemiology outlined offers an explanation for the seasonal incidence of St. Louis encephalitis and for the persistence of the disease from year to year in a given community. Also it might explain adequately why so few major epidemics have been observed, since the requisite conditions appear to be exacting. Factors which probably would influence these conditions are temperature, relative humidity, the number of chickens in the community, the population of chicken mites, breeding places for mosquitoes, prevalence of certain species of mosquitoes, availability of susceptible vertebrates in the community, and the like. The few endemic cases which have been observed from year to year could be explained by assuming that in any given year relatively few mosquitoes might acquire the virus from chickens and that only a few individuals might be exposed to the bite of such infected mosquitoes.

Since the natural history of equine encephalomyelitis has many similarities to that of St. Louis encephalitis, it is conceivable that the same epidemiologic factors might be involved. The isolation by Sulkin of the virus of equine encephalomyelitis from chicken mites collected in nature and the presence of

the virus of equine encephalomyelitis in the bird mite, Liponyssus sylviarum, as shown by Reeves, Hammon, and their associates lend support to this suggestion. (J. Exper. Med., 1 Feb '48 - M. G. Smith et al.)

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A Simplification of the Diagnosis of Varicose Veins: From teaching experience, as well as from contact with the practicing physician, it is evident that much confusion exists with respect to the diagnostic procedures which have been described in the treatment of varicose veins. Since the institution of appropriate therapy depends entirely upon an accurate diagnosis, this phase of the subject is particularly important.

A re-evaluation of the five tests commonly described in every treatise on this subject reveals that three of them, namely the Perthes', compression, and Schwartz tests, furnish no information that cannot be obtained by more accurate methods and hence no longer have a place in the diagnosis and treatment of varicose veins.

The Brodie-Trendelenburg test forms the basic part of the test used by the authors. In this test the affected leg is elevated and the veins emptied by gravity. A tourniquet is then applied around the upper thigh, sufficiently tight to constrict the saphenous vein, but not the femoral vein. The patient then stands upright, and the degree of filling of the saphenous vein is noted with the tourniquet in place and again with the tourniquet removed. A negative test is one in which, with the tourniquet in place, the veins fill within a period of 30 seconds, and upon removal of the tourniquet, no increased rate of filling is observed (Fig. 1). Here, it is apparent that no retrograde flow is taking place



FIG. 1.—STEP I: Negative Brodie-Trendelenburg Test

(A) Tourniquet On: Varicosities distended at end of 30-second period due to reflux from communicating veins.

(B) Tourniquet Off: No further distention of varicosities upon removal of tourniquet, indicating competency at the saphenofemoral junction.

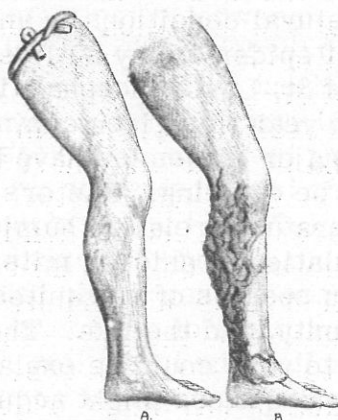


FIG. 2.—STEP I: Positive Brodie-Trendelenburg Test

(A) Tourniquet On: The varicosities remain collapsed throughout the 30-second period.

(B) Tourniquet Off: Rapid filling of the veins occurs from above indicating incompetency of the valves at the saphenofemoral junction.

through the saphenofemoral junction, and that the filling was due to an incompetency of the communicating veins. In a positive Brodie-Trendelenburg test, when the patient stands with the tourniquet in place, the varicosities will remain collapsed throughout the 30-second period, but upon release of the tourniquet, the internal saphenous rapidly fills with blood from above (Fig. 2). Here, the valves in the saphenous vein at the saphenofemoral junction are incompetent, although the valves of the communicating veins are still intact. A so-called doubly-positive test (Fig. 3) is one in which, with the tourniquet in place, the veins fill rapidly, and with the release of the tourniquet, even further distention of the veins takes place. In this case, the valves at the saphenofemoral junction as well as the valves of one or more communicating veins are incompetent. In a Trendelenburg-nil test, with the tourniquet in place, and again with the tourniquet removed, there is only slow filling of the veins from below. This would indicate competency of the valves of both the saphenous and communicating systems of veins. It might be mentioned that considerable confusion exists in the literature between the Trendelenburg-negative and the Trendelenburg-nil tests as described above. In view of the fact that the Trendelenburg-nil demonstrates competency of the valves of both the saphenous and communicating systems of veins, it would seem that in such a case an individual would not have true varicose veins, and that this part of the interpretation of the test is unimportant.

This test accomplishes two purposes: First, it demonstrates any existing retrograde flow of blood through the saphenofemoral junction. Secondly, it indicates the presence of one or more incompetent communicating veins between the superficial and deep venous systems, although it does not establish the level of such a vein. By its use, therefore, it may be determined whether or not high ligation of the saphenous and its branches is indicated, and, secondly, whether or not an additional ligation at a lower level is necessary.

The Mahorner-Ochsner (comparative tourniquet) test, although affording quite complete information about the status of the superficial and deep circulations of the leg, is somewhat complicated, and the information revealed is largely of academic interest and is not actually essential to the intelligent management of the patient with varicose veins. For example, an incompetency at the saphenofemoral junction can be demonstrated even more clearly in the Brodie-Trendelenburg test than in this test. Also, it can be learned from the Brodie-Trendelenburg test whether or not any incompetent communicating veins exist below the level of the tourniquet. The actual level at which such an incompetent communicating vein exists is, in most instances, unimportant, since once the presence of such a vein has been established, low ligation of the internal saphenous below all of the communicating veins in the thigh will produce the desired result in the lower leg. The segment of dilated vein in the thigh extending from the incompetent communicating vein to the level of the low ligation can nearly always be satisfactorily obliterated by subsequent injection therapy. In the occasional case in which such a varicosity would seem to persist, ligation of that communicating vein might be advisable, but it has been the experience of the authors that the Mahorner-Ochsner test does not accurately localize its exact site. They have instead determined this level by marking the uppermost portion of the dilated segment, and making a vertical

incision in this area through which the dilated vein is dissected upward to the site of the communicating vein which is then ligated.

A practical simplification of the Mahorner-Ochsner test, therefore, would be to perform the Brodie-Trendelenburg test, which, as stated previously, demonstrates the presence of any existing communicating veins, following which a single tourniquet is applied just above the knee which will indicate whether the incompetent communicating veins lie above or below this level (Fig. 4). If above this level, ligation just above the knee is indicated in addition to ligation of the saphenous at the saphenofemoral junction. In other words, by performing the Brodie-Trendelenburg test with this modification, the comparative tourniquet test is unnecessary insofar as its value in determining the type of treatment indicated is concerned. The value of the part of the comparative tourniquet test which deals with the status of the deep circulation of the leg will be discussed later.

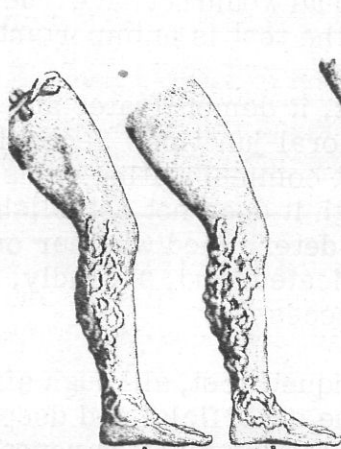


FIG. 3.—STEP I: Doubly-Positive Brodie-Trendelenburg Test

(A) Tourniquet On: Some filling of the veins occurs within 30 seconds due to a reflux through incompetent communicating veins.

(B) Tourniquet Off: Further filling of the varicosities occurs due to incompetency at the saphenofemoral junction.

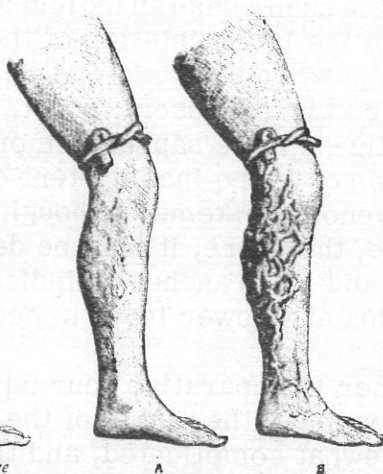


FIG. 4.—STEP II: Tourniquet Above Knee

(A) Varicosities collapsed because incompetent communicating veins lie above tourniquet.

(B) Varicosities distended because incompetent veins exist below the level of the tourniquet.

Throughout the literature, the determination of the status of the deep venous circulation has always been considered necessary before any effort was made to obliterate existing superficial veins. It was assumed that these superficial veins might be acting as collateral circulation around a point of obstruction in the deep venous system, in which case obliteration therapy would be contraindicated.

It has always seemed unlikely to the authors, however, that dilated, tortuous superficial veins, that is, typical varicose veins, the valves of which must

obviously be incompetent, could actually carry blood against the effect of gravity around a deep femoral thrombosis. Furthermore, it is difficult to understand how veins through which the Brodie-Trendelenburg test indicates a reversed flow of blood can be supporting collateral circulation. It would rather seem, therefore, that if the deep system of veins is occluded, and if the Brodie-Trendelenburg test indicates a retrograde flow of blood through the visible varicosities, there must be an intermediate system of collateral veins present to enable blood to escape from the leg. Thus, it would seem that in any case in which a retrograde flow of blood can be demonstrated by the augmented Brodie-Trendelenburg test described above, irrespective of the status of the deep circulation, not only will no harm be done by ligation, but the usual benefit to the varicose veins from this treatment should be expected, and even further improvement in the extremity obtained by lessening the load carried by the true collateral circulation. Moreover, by eliminating the varicose veins present, the tendency for superficial phlebitis (phlebitis migrans) to develop, as it so frequently does in patients who have had a deep femoral thrombosis, will be diminished.

It might be mentioned in further support of this theory, that simultaneous ligations of both the superficial and deep venous systems are routinely done by many surgeons in the active treatment of phlebothrombosis with no untoward results. Furthermore, in phlebothrombosis, the veins were essentially normal until the thrombosis occurred; that is, no time-interval for the development of a collateral circulation existed as it does in the case of chronic deep vein thrombosis.

When a new patient appears for examination, the usual history and physical examination are done. A diagnosis of varicose veins having been established, the following procedure is suggested.

Step 1. The Brodie-Trendelenburg test is performed, after which the status of the valves of the saphenofemoral junction as well as the existence of any communicating veins below this level should be known.

If the Brodie-Trendelenburg test is negative (Fig. 1), indicating that the valves of the saphenofemoral junction are intact, but that one or more incompetent communicating veins exist below the level of the tourniquet, the next step is performed.

Step II. The Brodie-Trendelenburg test is repeated with the tourniquet applied just above the knee instead of at the saphenofemoral junction (Fig. 4). If the varicosities remain collapsed, it may be assumed that all incompetent communicating veins lie above the level of the tourniquet, and ligation of the saphenous vein just above the knee is indicated. In the authors' experience, ligation here, without a ligation of the saphenous vein at the saphenofemoral junction, does not produce a complete nor permanent result, and in such cases it has been their custom to perform a high ligation of the saphenous, with its branches in addition. The segment of dilated vein in the thigh extending from

the incompetent communicating vein to the level of the low ligation can nearly always be satisfactorily obliterated by subsequent injection therapy. In the occasional case in which such a varicosity would seem to persist, ligation of that communicating vein might be advisable. This is accomplished by marking the uppermost portion of the dilated segment and making a vertical incision through which the dilated vein is dissected upward to the site of the communicating vein which is then ligated, and the dilated segment itself is excised.

If, on the other hand, the varicosities fill as rapidly as before the application of the lower tourniquet, one of two possible causes exists: (1) A retrograde flow of blood may take place from the popliteal vein to the external saphenous vein; or (2) a retrograde flow of blood may pass from the deep to the superficial veins of the calf through the communicating veins of the lower leg. In either event, one further step is then indicated.

Step III. The Brodie-Trendelenburg test is again repeated, this time with the tourniquet just below the level of the entrance of the external saphenous vein into the popliteal vein (Fig. 5). If the veins now remain collapsed with

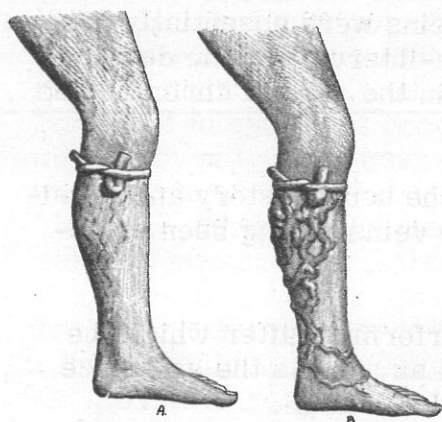


FIG. 5.—STEP III: Tourniquet Below Knee

(A) Varicosities collapsed because incompetency exists at entrance of short saphenous into the popliteal above level of tourniquet.

(B) Varicosities distended because incompetent communicating veins exist below level of tourniquet.

the tourniquet in place, it may be assumed that a valvular incompetency exists at the entrance of the short (external) saphenous vein into the popliteal, and ligation should be performed at this point. Should the veins, however, fill as rapidly as before, it is assumed that the incompetency exists in the communicating veins of the lower leg, and injection therapy alone will produce a satisfactory result in nearly every instance. Here again, if a dilated vein should persist after several injections, local excision of this vein and ligation of the communicating vein through a vertical incision can easily be done.

If the Brodie-Trendelenburg test is positive at the saphenofemoral junction (Fig. 2), indicating incompetency

of the valves at this site, it is immediately known that high ligation alone is indicated. Occasionally, a few supplementary injections may be necessary if any residual varicosities exist when this has been done.

If the Brodie-Trendelenburg test is doubly-positive (Fig. 3), indicating an incompetency of the valves both at the saphenofemoral junction and in the communicating veins below this level, it is known at once that high ligation is indicated, but Step II, and possibly Step III, will be required to disclose the type of supplementary therapy necessary. The performance and interpretation of these

steps has been described in the technic of the test under the negative Brodie-Trendelenburg test, just preceding.

Since it has been shown above that there is no need to determine the status of the deep circulation, the clinical examination of the patient with varicose veins is completed at this point. However, there are occasional cases in which actual roentgenographic visualization of the veins of the leg is necessary to arrive at the proper plan of therapy. It has been found that venographic studies are helpful in instances in which swelling, induration and obesity have rendered certain features of the clinical examination inconclusive. Moreover, when patients have responded poorly to adequate therapy, venograms have occasionally demonstrated an undetected incompetent communicating vein, or an anomalous saphenous vein. (Ann. Surg., Feb. '48 - C. A. Steiner and L. H. Palmer)

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Trends Concerning Water Potability: A report by the Committee on Water Supply of the American Public Health Association concerns current trends bearing upon the potability of water supplies.

Chlorination. There has been continued progress in the application of free residual chlorination and in the use of improved tests for free residual chlorine, as distinguished from combined residual chlorine. The orthotolidine-arsenite test has been modified by representatives of the Wallace and Tiernan Company, Inc., to facilitate the determination of residuals beyond the range of the usual standards through the use of the so-called "dilution method" or the "drop dilution method." One important aspect of the first method is the use of ordinary distilled water for dilution purposes rather than specially prepared water of zero chlorine demand. This development is of practical significance because free residual chlorination frequently requires the maintenance of residuals in excess of 1 p.p.m. at the control point. It is pertinent to emphasize again that these tests will not accurately distinguish between free and combined residual chlorine if the temperature of the sample being tested is higher than from 60° to 70° F.

These newer tests have shown that many raw waters contain sufficient manganese to produce a false color with orthotolidine or sufficient ammonia to result in the formation of chloramines, that is, combined residual chlorine. Under the latter circumstances many operators have assumed that conventional chlorination rather than chloramination was being practised, merely because ammonia was not applied. These tests, therefore, are of basic importance even when free residual chlorination is not practised intentionally.

Frequent references in the literature are made to the phrase "free residual chlorine" as being synonymous with hypochlorous acid. There is a distinction, however, between molecular chlorine, hypochlorous acid, and the hypochlorite ion. This distinction is of basic practical importance because molecular chlorine is not present as such in chlorinated waters having the usual pH values and also

because hypochlorous acid is much more active as a disinfectant than the hypochlorite ion. The relative proportion of free residual chlorine which is present as molecular chlorine, hypochlorous acid, and as hypochlorite ion is shown in the table below.

pH	% of Free available chlorine as:		
	Molecular Chlorine	Hypochlorous Acid	Hypochlorite Ion
4.0	0.5	99.5	0.0
5.0	0.0	99.5	0.5
6.0	0.0	96.5	3.5
7.0	0.0	72.5	27.5
8.0	0.0	21.5	78.5
9.5	0.0	1.0	99.0
10.0	0.0	0.1	99.9

It will be noted that molecular chlorine is present only at low pH values and that above pH 7.5, 50 percent or more of the free residual chlorine is present as the hypochlorite ion. Therefore, disinfecting properties of the hypochlorite ion must be considered when waters of high pH value are chlorinated. Unpublished data from the Harvard Engineering School are reported to disclose that the

hypochlorite ion is much less active as a disinfectant than chloramines or combined residual chlorine at pH values greater than about 9.0, in spite of the adverse effect of high pH values upon disinfection by chloramines. On the other hand, Butterfield and co-workers have reported that free residual chlorine, which for the reasons noted above would be hypochlorite ion at high pH values, is more effective than chloramines throughout the pH range.

It may be recalled, however, that the studies concerning the destruction of the virus of poliomyelitis by chlorine by Lensen, Rhian, and Stebbins show that, although the action of chloramines is much slower than that of free residual chlorine, nevertheless the action of chloramines is much less influenced by changes in pH than that of free residual chlorine.

Irrespective of the effects of pH of chlorinated waters, it is significant that the virus of poliomyelitis can be inactivated by doses of free residual chlorine or of chloramines producing residuals used in best current practice, provided a sufficient contact period is available. This is another example of the importance of the contact period in modern chlorination practice and of the need for selecting control points disclosing the residuals prevailing after appreciable periods.

Chlorine Dioxide. Chlorine dioxide has been continued in use with general success as a taste control process, especially when dealing with chlorophenol-like tastes. Recent studies by Ridenour and Ingols have shown that chlorine dioxide is an active disinfectant, and that the action is not as much influenced by high pH values as that of chlorine. The recent development by the Mathieson Alkali Works, Inc., of a laboratory technic to distinguish between residual chlorine dioxide and residual chlorine in water will permit such studies to be simplified and to be conducted on a plant scale.

Fluorination for the Prevention of Dental Caries. Research concerning whether the application of sodium fluoride to a public water supply will result in significant reduction in the incidence of dental caries is in progress at the following places: Brantford, Ontario; Evanston, Ill.; Grand Rapids and Midland, Mich.; Newburgh, N. Y.; Sheboygan, Wis.; and at the Southbury Training School, Southbury, Conn. In the meantime the principles enunciated by Wolman

should be given consideration by public health and water supply officials, namely:

1. Water works officials should avoid medicating water supplies pending definite results of controlled research now in progress and until the results have been reviewed and assayed by competent medical, dental, and public health officials.
2. The treatment of diseases other than through the medication of community water supplies should be thoroughly evaluated from the professional and economic standpoint.
3. The universal application of chemicals to potable waters for medication purposes should rest upon only substantial unanimity of opinion by official medical and public health agencies.
4. There should be complete concurrence between officials of the water department and of the health department of a municipality considering such treatment.

High Rate Filtration. There is a need for concerted effort, on the part of engineering staffs of state departments of health, to evaluate the significance to public health of high flocculation and sedimentation units and of high rate filtration, so that the official approval of plans will be based upon sound policy which will protect the public health, and at the same time not hamper present trends in the development of relatively smaller and less costly but effective treatment plants.

Sodium Content of Potable Water and Disease. The sodium content of potable water supplies, such as zeolited softened waters, has not been considered heretofore from the standpoint of potability. The upper limit is stated to be 200 mg. per day, which is equivalent to the consumption of 2 liters of water containing 100 p.p.m. of sodium. A great deal of research is required before this problem can be settled, but the subject is being discussed at this time to focus attention upon the possible importance of many ingredients of potable waters which may have been overlooked heretofore and to encourage further study so that this problem can be clarified.

Nitrate Content of Water and Cyanosis. Studies by Comly and by the Iowa Department of Health have focused attention upon the possible connection between nitrate content of potable water fed to infants, or used in the preparation of milk, and cyanosis or discoloration of the skin due to changes in the blood. Tentative conclusions have been reached that the nitrate content should not exceed 20 p.p.m. Ordinarily the nitrate content of potable water is less than this value. Investigations in Iowa, however, disclose values as high as 900 p.p.m., with values over 50 p.p.m. in about 10 percent of the total number of samples examined. It would seem that these excessive concentrations of nitrates must be of natural origin or due to the use of artificial fertilizers, because the nitrification

of sewage in the soil apparently would not lead to values such as those noted. Studies are being continued of a few selected wells on farms to secure more detailed information.

Toxic Ingredients of Potable Waters Incidental to Algae Growths: The possible presence of toxic ingredients in potable waters supporting a prolific growth of blue-green algae continues to be considered because such growths have been associated with outbreaks of water-borne gastroenteritis where the water supplies have conformed to bacteriological standards of the U. S. Public Health Service. The literature indicates that the toxic agent in algae affects the central nervous system of animals but does not produce enteritis. No definite data are available, however, concerning any effect upon human beings. There is need for research in this field so that the possible role of algae growths in water-borne gastroenteritis can be settled. (Am. J. Pub. Health, Feb. '48 - Cox et al.)

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Reports on USN Research Projects:

An Investigation of Corrective Training of Color Blindness. The training or coaching of those with color blindness to pass military color vision tests has, for several years, been of particular importance to the Navy. Unlike many other services, Naval service presupposes normal color vision in its personnel, and consequently many Naval operations are coded on color. It is bad enough to have a color-blind man in the Navy who knows he is color blind, but it is more dangerous to harbor color-blind men who believe that their vision is now normal because they have been "cured."

The opinions of nearly every authority on color vision in America are represented in this study. They indicate that the best informed and most experienced specialists in the field of color vision are emphatically of the belief that congenital color deficiency cannot be remedied by the use of diet, medicine, training, or other treatment now known to science.

Although practice and coaching will undoubtedly enable a color-blind person to pass, or to show an improved score on an imperfect test, there is no well established proof that training a person to pass a color-blind test contributes to rehabilitation in the true sense of the word, because the skills developed have no practical value except that of defeating the purpose of the screening test.

The only aspect of color blindness that can probably be modified by training methods is the ability to differentiate chromas, and the tests used for measuring improvement should concentrate on this aspect of the problem. Improvement measured by such means could not be interpreted as a claim to have made changes in the other and more basic aspects of color blindness. A program formulated on these principles would also be of value in training persons with normal color vision to achieve a finer discrimination of colors. (Color Vision Rep. No. 15, 15 Jul '47, Nav. Sub. Base, New London, Conn. - D. Farnsworth)

Evaluation of Electronic Cooking Device (Radarange) for Submarines. The Radarange in its present stage of development cannot be considered practicable for installation on submarines. As long as supplementary equipment for baking, boiling, and keeping food warm is required, necessitating the maintenance of at least one electric range unit along with the Radarange, and as long as the small oven capacity of the Radarange ultimately cancels the power advantage over the electric range, the apparent advantages of electronic cooking are nullified in practical application for Naval use. Moreover, the relatively short life of the magnetron tube makes necessary very frequent and expensive replacements. Also, the microwaves emanating from present tubes have limited penetrating powers incompletely cooking large cuts of meats. Bread prepared in the Radarange is doughy in spots and has a poor texture. Until these major shortcomings are successfully overcome, the installation of the Radarange cannot be recommended.

In favor of the Radarange, the absence of smoke, fumes, grease, the moderate heat radiation in food preparation, and the possibilities of short-order cooking should be pointed out.

Tests by the Quartermaster Food and Container Institute for the Armed Forces indicate that the vitamin content of foods prepared by electronic cooking is slightly higher than that prepared by the conventional electric range. (Proj. NM 011 016, Oct. '47, Nav. Sub. Base, New London, Conn. - L. Sussman)

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Extra Compensation for Doctors and Dentists Subject to Federal Income

Tax: Because BuMed has been questioned on several occasions concerning the taxability of the added compensation of \$100 per month granted medical and dental officers of the Army, Navy, and Public Health Service, according to the terms of Public Law 365 - 80th Congress, the Commissioner of Internal Revenue was requested through the Chief of the Bureau of Supplies and Accounts to rule upon the subject. On 16 February 1948, the Commissioner ruled that such compensation constitutes gross income within the meaning of Section 22(a) of the Internal Revenue Code; that it represents additional active service pay. Therefore, to the extent that it, together with other active service pay received during each of the taxable years 1947 and 1948, exceeds \$1500, it must be reported as gross income for federal income tax purposes. (M. D. Willcutts, Acting Chief, BuMed)

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Status of V-12 Medical and Dental Officers: An important notice concerning the status and opportunity offered to medical and dental officers of the V-12 Program appears under Alnav #20 on page 30.

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BuPers Circular Letter 48-19

12 February 1948

To: All Ships and Stations

Subj: Physical Examinations of Officers Preliminary to Promotion

- Refs: (a) Alnav 3-48; N.D. Bul of 15 Jan 1948, 48-7.
(b) Courts and Boards, 860, 861, 863, 864, 865.
(c) SecNav ltr of 9 Dec 1947, quoted in BuPers Circ Ltr 248-47; N.D. Bul of 31 Dec 1947, 47-1198.
(d) BuPers Circ Ltr 17-48; 48-90, this issue.
(e) BuPers-BuSandA joint ltr of 12 Sept 1946, as amended; AS&SL July-Dec 1946, 46-1887, p. 458.

1. From time to time, as officers become due for promotion, they will be informed by the Bureau of Naval Personnel in circular letters or by other appropriate methods. It is directed that each officer whose name is so published shall report for physical examination preliminary to promotion in accordance with references (a) and (b) at such time as his duties will best permit and when directed by his commanding officer.
2. The physical examinations will be conducted by a board of medical examiners convened in accordance with the authority contained in reference (c). The report of the board of medical examiners will be forwarded to The Judge Advocate General.
3. Upon the completion of physical examination, each officer will inform BuPers (attention: Pers-321) that he has reported for physical examination preliminary to promotion to the grade of on 1948 at in accordance with directive contained in (BuPers Circ Ltr etc.), and state whether he has any objection to being examined professionally on his record by the Naval Examining Board, Navy Department, Washington, D. C., in accordance with reference (d). Such waiver by an officer will be with the understanding that in the event of an unfavorable report by the Naval Examining Board at Washington, D. C., his right to appear later before a naval examining board will not be jeopardized.
4. In order to complete the record of the officer to be examined, it is directed that there be forwarded to the Bureau of Naval Personnel, Navy Department, a report on fitness covering the period from the last report on fitness to the date said officer is directed to report for physical examination, unless, in accordance with existing instructions, a report on fitness has been submitted for a period within 60 days of such date. The report will bear at the top thereof a notation that it is submitted at the time of physical examination for promotion.
5. Travel should be restricted to a necessary minimum. Where travel orders are necessary, they may be issued by the commands authorized in reference (e).

If this is not practicable, the Bureau of Naval Personnel will issue travel orders on request.

--BuPers. J. W. Roper

Note: It would appear from a review in the Bureau of Medicine and Surgery and the Judge Advocate General's office of the Record of Proceedings of Boards of Medical Examiners, that members of these Boards are not entirely familiar with Chapter 12 (pages 399-407, inclusive) of Naval Courts and Boards which has to do with Boards of Medical Examiners. Now that the Navy and Marine Corps have returned to peacetime procedure for appointment and promotion, it is necessary, in this connection, that medical officers carefully study Naval Courts and Boards. Attention is invited to paragraphs 882 and 883 of Chapter 12, and variations for boards to use in connection with the reporting of their physical examination and recommendations.

With the exception noted in paragraph 860, all Naval officers found fit for promotion must be physically qualified to perform all their duties at sea, and Marine Corps officers qualified to perform all their duties at sea and in the field.

For example, if the physical examination indicates that an officer requires further observation to determine whether or not he has active tuberculosis, variation 3 under (9) in paragraph 882 may be used. In order for the board to be consistent in its findings, it should use variation 3 under (10) in paragraph 883. (P.Q. and M.R. Div., BuMed)

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Circular Letter 48-10

23 January 1948

To: Ships and Stations (Selected List)

Subj: Radiological Safety Regulations

- Refs: (a) CNO ltr Op-602/cmf Ser 021P602 dtd 27 Aug 1946.
(b) BuShips-BuMed conf spdltr Ser 1381 of 24 Sep 1946.
(c) BuShips-BuMed conf disp 141550Z of Oct 1946.
(d) BuShips-BuMed conf spdltr All/Crossroads/S99-2 of 6 Nov 1946.
(e) BuShips-BuMed conf ltr BuShips Code 180A All/Crossroads/C-3 (99)-(O) of 22 Nov 1946.
(f) BuMed ltr EN10/RadSafe P2-4 conf of 31 Jan 1947.
(g) BuMed conf disp 072046Z of Mar 1947.
(h) BuMed conf ltr BuMed-7 RadSafe/P2-5 of 21 Apr 1947.
(i) BuMed ltr BuMed-74-B-ceg L21 Ser 5018 of 20 May 1947.
(j) BuMed ltr conf BuMed-74-KI-ceg L9-7/RadSafe Ser 05017 of 20 May 1947.
(k) BuMed conf ltr BuMed-74-S-mlm L9-7(4)/A9 Ser 05029 of 15 Sep 1947.

Encl: A. (HW) Radiological Safety Regulations.

1. References (b) thru (k) are not available to, nor needed by all addressees.
2. By reference (a) the Bureau of Medicine and Surgery is charged with the responsibility for formulating radiological safety regulations and for establishing tolerances applicable to the radiological safety program of the Navy. Enclosure A has been prepared on the basis of experience gained in the field of radiological safety operations connected with work which has been done over the past several years, as a result of Operation CROSSROADS, and from other experience. The regulations established in Enclosure A are effective from this date. Those portions of references (b) thru (k) and other instructions in conflict with these regulations are hereby canceled.

--BuMed. C. A. Swanson

Approved

A. W. Radford

Vice Chief of Naval Operations

Note: Although dated 23 January 1948 this letter has just been approved for release but will not likely reach addressees for another 3 or 4 weeks, representing the time required for having the enclosure printed into booklet form.

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ALNAV 20

1 March 1948

Subj: Re Status of V-12 Medical and Dental Officers

Refer Alnav 281-46 as modified by Alnavs 379-46 and 556-46. No repeat no Naval Reserve medical or dental officers as defined in above alnavs who have voluntarily reported or may voluntarily report for active duty on or subsequent to 1 September 1947 shall be considered as coming within the purview of these alnavs. Status of Reserve medical and dental officers now performing obligated service under these alnavs who reported or were ordered to report for involuntary active duty prior to 1 September 1947 not affected by this alnav. Attention invited to paragraph 2, Alnav 184-47.

--SecNav.

Note: Alnav 281-46 of 29 May states that all Naval Reserve medical officers who are graduates of the V-12 training program and Naval Reserve dental officers who were educated wholly or in part by the government will no longer be released to inactive duty under present demobilization procedures. Such medical officers will be retained on active duty for 2 years after completion of internship and such dental officers for a period of 3 years after reporting for active duty. This period of 3 years' service requirement is reduced to 30 months effective 1 September 1946 by Alnav 379-46; and again reduced to 24 months effective 1 November 1946 by Alnav 556-46.

Paragraph 2 of Alnav 184-47 states that Reserve medical and dental officers performing obligated service in accordance with Alnav 281-46 are specifically excluded from additional compensation accorded medical and dental officers by Public Law No. 365, 80th Congress. Such personnel may establish eligibility for added compensation by transfer to the regular Navy at any time during the period of obligated service or during the 5-year period following 1 September 1947 after completion of their obligated service.

In its effects, then, Alnav #20 above sets a cut-off date for the application of the provisions of Alnav 281-46 to the cases of medical and dental officers of the U. S. Naval Reserve educated wholly or in part under the Navy V-12 Program. Therefore, notwithstanding the extent of active participation in the V-12 Program during the course of their pre-professional or professional education, physicians and dentists now or hereafter commissioned in the Medical and Dental Corps of the U. S. Naval Reserve who enter upon active duty pursuant to first orders dated on or after 1 September 1947 shall be considered as in a fully voluntary status; and shall be eligible to receive the added compensation of \$100.00 per month accorded medical and dental officers by Title I of Public Law 365, 80th Congress, provided their term of active service has been voluntarily set at one year or longer.

The status of medical and dental officers of the U. S. Naval Reserve now performing obligated service who commenced (or were ordered to commence) active duty in compliance with first orders dated prior to 1 September 1947 is not altered by this directive. As pointed out in paragraph 2 of Alnav 184-47, however, the officers in this category may qualify for the added monthly compensation of \$100.00 at the expiration of their term of obligated service by executing an agreement to continue active duty for one year or longer beyond that date; or, at any time during the period of their obligated service by effecting appointment in the Regular Navy under the provisions of the Transfer Program or by qualification on professional examination. (Professional Div., BuMed)

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Circular Letter 48-23

26 February 1948

To: Distribution List

Subj: Naval Medical Supply Depot, Pearl Harbor, T. H.: Mission of

Ref: (a) CNO ltr Op-40U-1er NT4-30/A3-1 Serial 58P40 to BuMed, dated 21 Jan 1948.

1. In accordance with the authority contained in reference (a), the mission of the Naval Medical Supply Depot, Pearl Harbor, T. H., is as follows:

(a) To procure, store, prepare for shipment, and deliver to transshipment agencies standard medical supplies and equipment for all U. S. Naval and Marine Corps activities and forces of the 14th Naval District, including Midway, Johnston, and Palmyra Islands.

(b) To procure, store, prepare for shipment, and deliver to transshipment agencies standard medical supplies and equipment for all Naval and Marine Corps forces in the Marshall Island subarea, including Kwajalein, assigned craft, and naval air and defense forces.

(c) To procure, store, prepare for shipment, and deliver to transshipment agencies standard medical supplies and equipment for all naval controlled personnel at American Samoa.

(d) To maintain on hand, in accordance with CNO approval, such reserves of standard medical materials in stock as may be directed by the Bureau of Medicine and Surgery.

(e) To provide facilities for, and accomplish the salvage and repair of medical supplies and equipment.

(f) To identify and dispose of navy surplus materials under the control of the Naval Medical Supply Depot.

(g) To perform such stores and cost accounting functions as may be designated by the Bureau of Medicine and Surgery.

(h) To perform such additional accounting, incident to proper function of the depot, as may be designated by COM14.

--BuMed. H. L. Pugh

Note: The distribution list which is not reprinted in the News Letter contains 34 addressees made up of offices of the Navy Department and activities ashore and afloat.

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Circular Letter 48-24

26 February 1948

To: All Ships and Stations

Subj: Purchase Requisitions for Medical and Dental Supplies, Equipment and Services, Forms SandA 76 and 44; Preparation and Submission of

Refs: (a) Paragraph 33021 BuSandA Manual
(b) Paragraph 23100 BuSandA Manual
(c) Accounting Classification, Vol. VII, BuSandA Manual

This letter from the Acting Chief of BuMed states that all purchase requisitions, Forms 76 and 44, BuSandA, requiring the approval of the Bureau of Medicine and Surgery will be submitted directly to the Bureau of Medicine and Surgery, Navy Department, Washington 25, D. C., with the exception of those from activities under the cognizance of the Pacific Requisition Control Agency, that these latter activities shall submit Forms SandA 76 and 44 to the Pacific Requisition Control Agency for processing and transmittal to the Bureau of Medicine and Surgery, and gives certain instructions concerning preparation of these requisitions.

Note: See Navy Department Bulletin of 29 February 1948 for full letter.

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